IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

APPLICATION NO.	:	10/550,256
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TC/AU	:	2834
TITLE	:	PUMP MOTOR WITH BEARING PRELOAD
CUSTOMER NO.	:	23638
APPLICANT	:	HARGRAVES et al.
EXAMINER	:	KIM, JOHN K
DOCKET NO.	:	2974/2US

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DECLARATION OF DOUGLAS ALLAN CURTIS
PURSUANT TO 37 C.F.R. § 1.132

Douglas Allan Curtis, declares and says:

1. I am a named co-inventor in the above-referenced application. I am an engineer with 10 years of experience in motor design and operation. I have personal knowledge of the facts set out in this Declaration, except as to those facts stated upon information and belief, and as to those facts, I believe them to be true.

2. The claimed motor was derived as a result of successive failures to achieve a motor with a long operational life, and which operated during its life span without

loosening of components due to thermal expansion. This is an important consideration in many applications where both a reliably long motor life and quiet motor operation are important considerations.

3. One of the significant applications of the claimed motor is operating a reciprocating load medical pump used for peritoneal dialysis. Upon information and belief, peritoneal dialysis ("PD")is a treatment for patients with severe chronic kidney failure. Fluid is introduced into the abdomen, which draws out water, salts and waste products from the blood through diffusion. A catheter is inserted through the abdominal wall and used to introduce the fluid. One form of PD, continuous ambulatory peritoneal dialysis (CAPD), does not require a motor and pump. As the word ambulatory suggests, the patient can walk around with the dialysis solution in his or her abdomen. Another form of PD, continuous cycler-assisted peritoneal dialysis (CCPD), requires a machine called a "cycler" to fill and drain the abdomen, usually while the patient sleeps. CCPD is also sometimes called automated peritoneal dialysis (APD). The fact that the patient usually performs CCPD while sleeping requires a motor that is both reliable and quiet.

4. In designing an aluminum motor for this application, applicant first attempted to secure the motor components together using aluminum components connected together with two bolts extending through the end bell and housing. After a relatively short period of operation, the motor parts loosened, creating both component wear and an unacceptable noise level.

5. Applicant increased the number of bolts to 4, with the same results.

6. Applicant then designed a motor with a steel housing and aluminum end bells connected with 4 bolts, with the same unacceptable results. In each case, the motor components loosened as the operating temperature of the motor increasead, reducing motor life and creating noise as the loosened parts contacted each other at a rapid rate.

7. Finally, applicant designed a motor with a steel housing, steel end bells, a steel shaft and steel bearings. The components were preloaded with a steel spring into a preloaded operating position and adhesively locked into the preloaded operating position.

8. This motor preload design enabled several market application advantages for miniature diaphragm pumps that are powered by it. These advantages include the ability to operate miniature diaphragm pumps at greater performance loads (pressure and/or vacuum) and under greater thermal delta environments while achieving exceptional operational life and fitting into a very small envelope size. Applicant has therefore been able to warrant its pumps configured with this motor design for 10,000 hours of operation. No competitor of applicant that sells similar products provides such a warranty. In addition, most competitive pumps will specify a maximum ambient temperature of 40°C on their data sheets, whereas applicant specifies 50°C as a maximum ambient temperature for the claimed motor.

9. This product design with the now claimed enhancement has enabled applicant to earn business in several market applications that required the above benefits over competitive offerings that did not thoroughly meet the customer's design and performance objectives. As a result, applicant earned revenue of $2.0M in 2007 and

$2.3M in 2008 that is attributed to this specific motor design configuration, as presently claimed.

10. Previous pump motors used in the cycler had a service interval that required the pump to be rebuilt or replaced at an unacceptably high frequency, requiring the pump and motor to be pulled out of service to be rebuilt. Accelerated reliability testing on the claimed motor has proven that the motor is good for the life of the cycler. In fact, the pumps are still on the fixture with no failures with over 10 years of accelerated life testing. This appears to be five times the life of motors not having the claimed design features.

11. The claimed motor is also less expensive and substantially quieter. Prior motors quickly developed a whine that could not be dampened with available sound abatement material. This is a serious drawback for a product that operates through the night while the user sleeps. The cycler is usually on a night stand next to the bed of the patient. The entire unit must be quiet for the patient and for his or her partner to sleep. Through the life test and periodic sound testing carried out to date, the claimed motor has not increased in sound level.

12. Another such application for the claimed motor is for portable oxygen concentrators. Due to the reduced size, weight, reliability and quietness, the claimed motor allows the device to be more portable while achieving performance and reliability requirements.

13. The Fries Patent discloses a submersible motor that has an electrically driven rotating mixer. The electric motor and hydraulic part are connected by a rotary shaft.

The shaft end opposite from the hydraulic part is resiliently supported in a stator casing which surrounds the motor. The motor is conventional, and says nothing regarding the relative coefficients of thermal expansion of the various motor components.

14. The Brown Published Application discloses a torque motor, including a partial rotation drive suitable for use in a galvanometer scanner, where the rotor is supported within the stator and housing assembly on all ceramic ball bearings, including inner and outer races and bearing balls. The ceramic ball bearing assemblies and structural support elements have substantially equal coefficients of expansion through the use of matched expansion, nickel-iron alloy for the rotor shaft, stator, housing and other structural components which contact, locate, and support the inner and outer bearing races. The non-conductive bearings permit exclusion of any grounding conductor strap as between the rotor shaft and the housing.

15. The Brown Published Application is directed to a completely different problem than the claimed invention. In Brown, the primary goal is to achieve a reciprocating motor with a galvanometer bearing arrangement that can tolerate no such gross dynamic changes in alignment:

> In galvanometer use, it is generally necessary to locate the axis of rotation within 1 micro-radian or less over very long periods of time, and over the full service temperature range. Also, the gyroscopic and other inertial load and rotor moments on the bearings must be resisted by a stiffness in the location and mounting of the bearings which generally prohibits the use of temperature-compensating springs of any sort. In fact, the inherent stiffness of the bearings themselves, while very high, is the source of the limiting axle-positioning errors in most cases. As a result, the complex, expensive, many-component art taught by these patents is entirely unsuitable for use in a galvanometer and other such rigorously precise rotary applications.

Brown Published Application, ¶ 0015.

16. These considerations have no place in the claimed invention. In particular, the claimed invention explicitly recites a biasing element such as a spring as an element of the invention, and not only does not "prohibit the use of temperature-compensating springs of any sort", but requires such a biasing element for its operation. In addition, the disclosure of the Brown Published Application is directed to a "partial rotation torque motor" used to move a scanner mirror. As such, the principal motivation to use "matched" components is to maintain the necessary degree of precision in the partial-rotation, reciprocating motor in the "1 micro-radian or less" range.
In contrast, applicant's motivation was to design a non-reciprocating motor that, when subjected to severe reciprocating radial loading, as from a diaphragm pump, retains its parts in a fixed relation so that wear and noise are minimized.

17. The undersigned declares further that all statements made herein of his own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

Douglas Allan Curtis

Date: 8/17/2K9